INSTRUMENTATION FOR UPPER OCEAN DYNAMICS TURBULENCE AND GAS TRANSFER RESEARCH

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LONG-TERM GOAL

We wish to improve our suite of instrumentation to measure upper ocean dynamics, turbulence, gas transfer and recording and computing equipment for data acquisition and real-time processing of data.

SCIENTIFIC OBJECTIVES

To measure high frequency turbulence and wave velocities with velocimeter instruments such as acoustic doppler velocimeter (ADV) and velocity-density-vorticity (VDV).

To measure accurately the wavenumber-directional spectrum, and its spatial and temporal variation with laser ranging gauges.

To measure the pressure above the waves, a key to understanding the wave generation problem on the ocean with sensitive MKS pressure transducers and Elliott pressure probes.

To use hot wire/film anemometry to resolve velocity components over the full range of scales -- from the large eddies to the Kolmogorov micro-scale. Modern constant temperature anemometer (CTA) systems are extensively used in gas transfer studies and investigations of turbulent kinetic energy properties in both phases (air and water) and in both environments (laboratory and field). To measure also temperature fluctuations with a constant current anemometer (CCA) module.

To measure the necessary corrections for the motion of the buoy with 6-degree of freedom inertial packages.

Report Documentation Page

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APPROACH

Both velocimeter instruments (ADV and VDV) will be used on the ONR-funded Air-Sea Interaction Spar (ASIS) buoys. Recent laboratory experiments have demonstrated that the ADVs are particularly well-suited for measuring Reynolds stress because the three acoustic axes are extremely well-matched and the VDV sensors have sufficiently low noise that they can measure turbulence spectra at frequencies above the wave band - thus providing estimates of turbulence kinetic energy and kinetic energy dissipation rates.

The laser gauges will provide accurate measurements of the wavenumber-directional spectrum, and its spatial and temporal variation, which is key to determining the overall energy (or wave action) budget. The spectra from surface-piercing gauges are not accurate at higher wavenumbers due to disturbances where the probes intersect the surface. However, the laser gauges will be non-invasive and pose no additional obstruction to fish or receive interference from floating sargassum or slicks on the surface.

The hot wire/film anemometry is capable of resolving velocity components over the full range of scales -- from the large eddies to the Kolmogoroff micro-scale. Modern constant temperature anemometer systems find application in laboratory and field work in both air and water. These sensors are critical in gas transfer studies and investigations of turbulent kinetic energy properties in both phases (air and water) and in both environments (laboratory and field).

WORK COMPLETED

1. The TSI hot-wire anemometry system has been acquired.

2. After a preliminary test of a laser altimetry, we suggested several modifications to the sampling of this sensor. We have acquired one modified RIEGL high speed laser ranger, which we will further evaluate and test before acquiring the remaining laser rangers.

RESULTS

None yet.

IMPACT/APPLICATION

None.

TRANSITIONS

None.

RELATED PROJECTS

The above instrumentation will complement existing instrumentation and sensing technology for air-sea interaction parameters. These sensors include sonic anemometers, radiation sensor, H_2O/CO_2 sensors, three-axes acoustic current meters and atmospheric pressure and temperature instrumentation. These sensors have been used on deployments of the ASIS buoy in the northeastern Gulf of Mexico as part of the NASA scatterometer (NSCAT) validation experiment.